250 Å. As the AFM layer thickness is decreased, its exchange coupling strength decreases due to the decreased grain size of the thinner layer. In order to achieve the desired weaker exchange coupling to the bias layer required for pinning the AP-tabs while maintaining high sensitivity for the SV sensor, the AFM layer **560** is formed of Pt—Mn having a thickness in the range of 30-100 Å. Alternatively, the AFM layer may be formed of Ir—Mn, Ni—Mn or other electrically conductive antiferromagnetic materials. The weak pinning field due to the thin AFM layer is particularly effective at the interfaces of the track width region and the first and second passive regions where the bias layer ends. At this discontinuity of the bias layers, demagnetization fields can result in destabilization of the free layer magnetization in the absence of a pinning field. A weak pinning field removes this instability without significant stiffening of the free layer magnetization **544** in the track field region. After the thin AFM layer has been deposited, a first cap layer **526** is formed on the AFM layer **560**.

[**0041**] First and second leads **L1528** and **L2530** are formed over the cap layer **526** in the passive regions **532** and **534** and over the end regions **502** and **504** overlapping the central region **506** of the sensor in the first and second passive regions. A space between **L1528** and **L2530** in the central region **506** of the sensor defines the track width region **536** which defines the track width of the read head and which can have submicron dimensions. The first cap layer **536** in the track width region **536** between **L1** and **L2** is removed by a sputter etch and reactive ion etch (RIE) process followed by a sputter etch and oxidation process to convert the AFM material **560** and the ferromagnetic materials of bias layer **522** into a nonmagnetic oxide layer **538** in the track width region **536**. A second cap layer **540** is formed over the leads **L1528** and **L2530** in the end regions **502, 504** and the passive regions **532, 534** and over the nonmagnetic oxide layer **538** in the track width region **536**.

[**0042**] The AP-pinned layer **512** has the magnetizations of the FM1 layer **517** and the FM2 layer **519** pinned in directions perpendicular to the ABS as indicated by arrow tail **542** and arrow head **543** pointing into and out of the plane of the paper, respectively. In the track width region **536**, the magnetization of the free layer **516** indicated by the arrow **544** is the net magnetization of the ferromagnetically coupled first and second free sublayers **520** and **521** and is free to rotate in the presence of an external (signal) magnetic field. The magnetization **544** is preferably oriented parallel to the ABS in the absence of an external magnetic field. In the first and second passive regions **532** and **534**, the free layer **516** is strongly AP-coupled to the bias layer **522**.

[**0043**] The magnetization **546** of the bias layer **522** in the first and second passive regions **532** and **534** is the net magnetization of the ferromagnetically coupled first and second bias sublayers **524** and **525**. Due to the presence of the APC layer **523** which allows the free layer **516** to be strongly AP-coupled to the bias layer **522** in the passive regions, the magnetization **546** of the bias layer is oriented antiparallel to the magnetization **545** of the free layer. The effect of this AP-coupling is stabilization of the free layer **516** in the passive regions **532** and **534** since the magnetization **545** does not rotate in response to external fields thus inhibiting undesirable side reading on the rotating magnetic disk. The weak pinning field from AFM layer **560** provides additional stabilization of the free layer **521** in the first and second passive regions **532** and **534** especially at the transition between the passive regions and the track field region **536**.

[**0044**] End region layers **548** and **550** abutting the spin valve layers may be formed of electrically insulating material such as alumina, or alternatively, may be formed of a suitable hard bias material in order to provide a longitudinal bias field to the free layer **516** to ensure a single magnetic domain state in the free layer. An advantage of having the hard bias material forming the end region layers **548** and **550** is that these layers are remote from the track width region **536** so that they do not magnetically stiffen the magnetization **544** of the free layer in this region, which stiffening makes the free layer insensitive to field signals from the rotating magnetic disk.

[**0045**] Leads **L1528** and **L2530** deposited in the end regions **502** and **504**, respectively, provide electrical connections for the flow of a sensing current I_S from a current source to the SV sensor **500**. A signal detector which is electrically connected to the leads senses the change of resistance due to changes induced in the free layer **516** by the external magnetic field (e.g., field generated by a data bit stored on a rotating magnetic disk). The external field acts to rotate the direction of the magnetization **544** of the free layer **516** relative to the direction of the magnetization **543** of the pinned layer **519** which is preferably pinned perpendicular to the ABS.

[**0046**] The fabrication of SV **500** is described with reference to **FIGS. 5 and 6***a-d*. The SV sensor **500** is fabricated in a magnetron sputtering or an ion beam sputtering system to sequentially deposit the multilayer structure shown in **FIG. 5**. The sputter deposition process is carried out in the presence of a longitudinal magnetic field of about 40 Oe. The seed layer **509** is formed on the substrate **508** by sequentially depositing a layer of alumina (Al_2O_3) having a thickness of about 30 Å, a layer of Ni—Fe—Cr having a thickness of about 20 Å and a layer of Ni—Fe having a thickness of about 8 Å. The AFM layer **510** of Pt—Mn, having a thickness in the range of 4-150 Å, is deposited over the seed layer **509**. The AP-pinned layer **512** is formed over the AFM layer by sequentially depositing the FM1 layer **517** of Co—Fe having a thickness of about 10 Å, the APC layer **518** of ruthenium (Ru) having a thickness of about 8 Å and the FM2 layer **519** of Co—Fe having a thickness of about 19 Å. The spacer layer **514** of copper (Cu) having a thickness of about 20 Å is deposited over the FM2 layer **519** and the free layer **516** is deposited over the spacer layer **514** by first depositing the first free sublayer **520** of Co—Fe having a thickness of about 10 Å followed by the second free sublayer **521** of Ni—Fe having a thickness of about 15 Å. The APC layer **523** of Ru having a thickness of about 8 Å is deposited over the second free sublayer **521**. The bias layer **522** is deposited over the APC layer **523** by first depositing the first bias sublayer **524** of Co—Fe having a thickness of about 10 Å followed by the second bias sublayer **525** of Ni—Fe having a thickness of about 20 Å. The AFM layer **560** of Pt—Mn having a thickness in the range of 30-100 Å is deposited over the second bias sublayer **525**. A first cap layer **526** deposited over the bias layer **522** comprises a first sublayer of tantalum (Ta) having a thickness of about 20 Å and a second sublayer of ruthenium (Ru) having a thickness